Control Systems – EEE 2002 Tutorial Exercise I

1. By using the general form of the analytic solution try to predict (without solving the ODE) the response of the following systems. Your answer must describe the system as stable/unstable, convergent to zero/nonzero value/sinusoid…
   - $5\frac{dx}{dt}+6x=0,\quad x(0)=0,\ x'(0)=1,\ x''(0)=-1$
   - $5\frac{dx}{dt}-6x=0,\quad x(0)=0,\ x'(0)=1,\ x''(0)=-1$
   - $5\frac{dx}{dt}+6x=1,\quad x(0)=0,\ x'(0)=1,\ x''(0)=-1$
   - $5\frac{dx}{dt}+6x=-1,\quad x(0)=0,\ x'(0)=1,\ x''(0)=-1$
   - $\frac{dx}{dt}+3=0,\quad x(0)=0,\ x'(0)=1,\ x''(0)=-1$
   - $5\frac{dx}{dt}+6x=\sin(50t),\quad x(0)=0,\ x'(0)=1,\ x''(0)=-1$
   - $5\frac{dx}{dt}+6x=\cos(50t),\quad x(0)=0,\ x'(0)=1,\ x''(0)=-1$
   - $5\frac{dx}{dt}+6x=5+\sin(50t),\quad x(0)=0,\ x'(0)=1,\ x''(0)=-1$
   - $5\frac{dx}{dt}+6x=\cos(50t)+\sin(50t),\quad x(0)=0,\ x'(0)=1,\ x''(0)=-1$
2. Using numerical solutions crosscheck your previous statements.
3. Simulate the analytic solution and hence crosscheck the results of Q1 and Q2.
4. Reproduce the results of all 2nd order systems that are shown in your lecture handout. Your answer must include prediction and explanation of response, crosscheck with numerical solutions and simulations of analytic solutions.
5. Repeat Q4 using damping factors and natural frequencies.